# LOWER CRETACEOUS SCLEROSPONGE FROM THE SLOVAKIAN TATRA MOUNTAINS

*by* JÓZEF KAŹMIERCZAK

ABSTRACT. The first fossil sclerosponge with well-preserved spicules is described as *Murania lefeldi* gen. et sp. nov. It comes from the Lower Cretaceous (Aptian) Muran Limestone of the Slovakian Tatra Mountains. The relationship of this sponge with recent sclerosponges is discussed and the affinities of the sclerosponges with the Palaeozoic stromatoporoids are briefly reviewed.

THE first fossil sclerosponges to be recognized as such have been found in thin sections of limestones donated to me by Dr. J. Lefeld (Institute of Geology, Polish Academy of Sciences). The samples come from the northern slope of Muran Mountain in the Lower Cretaceous Muran Limestone of the Sub-Tatric Succession of the Slovakian Tatra Mountains. The geological details and precise locality are given in Uhlig (1899) and Andrusov (1959). The most recent biostratigraphical investigations on the Muran Limestone (Lefeld 1974) indicate an Upper Hauterivian to Lower Aptian age; the association of *Orbitolina lenticularis* Blumenbach with the sclerosponges is a good indication of an Aptian age for these specimens. Lithologically the Muran Limestone comprises sparry calcirudites and coarse calcarenites. The sponges, together with a rich fauna, including green and red algae, (?)hydrozoans, echinodermal and shell debris occur as strongly abraded clasts. The clasts were probably derived from the Aptian reefs (Urgonian facies) of the nearby High Tatric zone (Lefeld 1968).

## SYSTEMATIC DESCRIPTION

### Class SCLEROSPONGIAE Hartman and Goreau, 1970
### Genus *Murania* gen. nov.

*Type species. Murania lefeldi* sp. nov.

*Diagnosis.* Encrusting sclerosponge with massive calcareous basal skeleton formed of closely spaced columns normal to the lower surface with irregularly polygonal cross-sections. The axial part of each column is occupied by upward radiating primarily siliceous spicules (styles). The spicules are embedded in amorphous carbonate. The outer part of each column is formed of fibrous calcite. The upper surface of the skeleton bears short, delicate calcareous processes.

*Derivation of name.* From Muran Mountain (Slovakian Tatra Mts.).

### *Murania lefeldi* sp. nov.

Plates 45, 46; text-fig. 1

*Holotype.* Thin sections Z.Pal.Pf.I/1a, b; Pl. 45, figs. 1–2; Pl. 46, figs. 1–7.

*Paratype.* Thin section Z.Pal.Pf.I/2.

*Derivation of name.* The species is named in honour of Dr. Jerzy Lefeld who collected the material.

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*Diagnosis.* A species of *Murania* with about half the breadth of the columnar skeletal units occupied by style (?acanthostyle) spicules radiating upwards with mean length of 200 $\mu$m and mean width (at the head) of 30 $\mu$m.

*Description.* Sheet-like, encrusting, calcareous skeleton usually less than 4 mm thick, associated with the calcareous alga *Lithocodium aggregatum* Elliott (Codiaceae). This alga encrusts and is encrusted by the sponge (Pl. 45, figs. 1–2; Pl. 46, figs. 1–3, 5; text-fig. 1). The rapid postmortal encrustation of the sponge skeleton by *L. aggregatum* was probably the main factor responsible for the preservation of the sponge surface in almost its original form. The skeleton is composed of distinct closely spaced columns with irregular polygonal cross-sections (Pl. 46, fig. 7; text-fig. 1B). The mean column thickness is 300 $\mu$m (min. 250 $\mu$m, max. 500 $\mu$m). The boundaries between columns are usually distinct, and are sometimes separated by a narrow zone frequently filled with sediment or algal carbonate (text-fig. 1). Each column is composed of two zones: (1) the central spicular zone, and (2) the outer fibrous zone. The spicular zone occupies about half the column breadth and is composed of style type spicules which radiate upwards, more or less regularly from the axis. The length of the spicules is between 150–220 $\mu$m (mean 200 $\mu$m); the width at the head is between 28–33 $\mu$m (mean 30 $\mu$m). It is difficult to determine whether the spicules are smooth styles or acanthostyles, since only thin sections were available. It is not clear whether the very fine notches visible on some of the spicules (Pl. 46, fig. 4) form primary ornamentation or are marks of secondary corrosion on the smooth styles. Where distinct, the spicules are calcite pseudomorphs, presumably after primary opal. However, many spicules have indistinct outlines due to imperfect replacement (Pl. 46, fig. 4). The spicules are usually quite closely spaced, often almost touching, especially at their heads. The distribution of the spicules is most evident at the upper surface of the skeleton where, very often, their moulds are filled by encrusting algal carbonate, darker than the surrounding sponge skeleton (Pl. 46, figs. 2–3, 5; text-fig. 1A). The upper surface of the least-corroded sponge fragments bear numerous irregular needle-like processes with an average length of 110 $\mu$m and width 12 $\mu$m forming a palisade around each spicule (text-fig. 1A). Deeper in the skeleton the spicules are embedded in amorphous and slightly flocculent carbonate, the dark coloration of which could indicate a considerable admixture of organic matter. The outer zone of each column is formed of densely packed, upward-radiating calcite fibres which are particularly evident in polarized light (Pl. 46, fig. 6).

*Discussion. Murania lefeldi* is the first fossil sclerosponge with well-preserved, though pseudomorphic, spicules in the basal calcareous skeleton. It differs from all described recent sclerosponges in that the skeleton is composed of columnar units,

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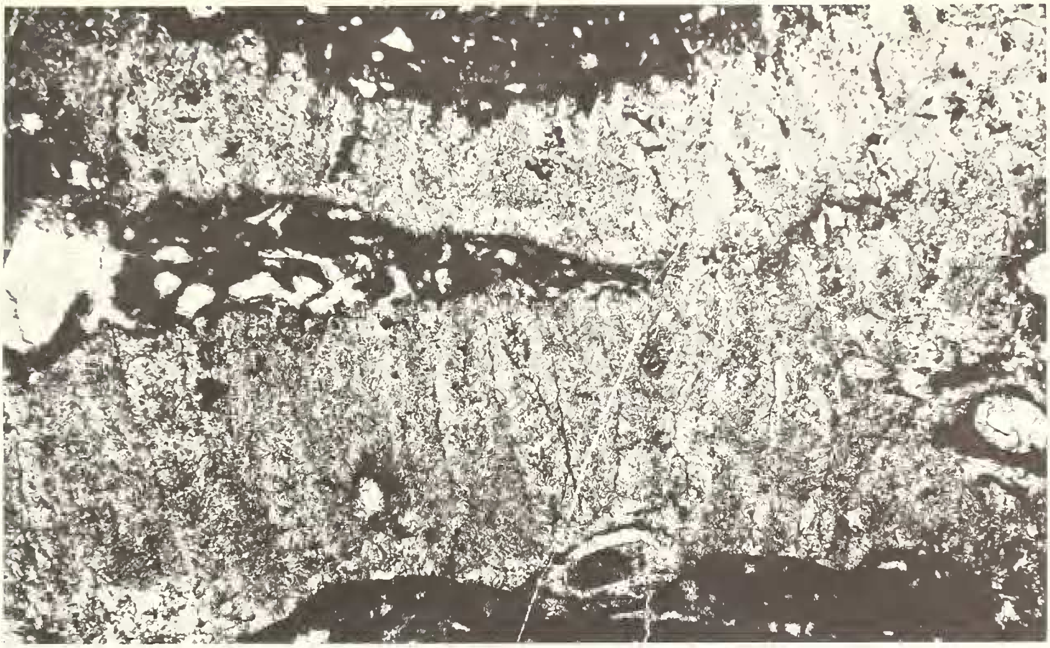
EXPLANATION OF PLATE 45

Figs. 1–2. *Murania lefeldi* gen. et sp. nov., × 15. Longitudinal sections showing sheet-like skeletons of the sponge interlayered and encrusted by codiacean calcareous algae *Lithocodium aggregatum* Elliott. The cross-section of the serpulid tubes overgrown by the sponge skeleton are visible in Fig. 1 (base and right). Note the columnar units composing the sponge skeleton. 1, thin section Z.Pal.Pf.I/1b. 2, thin section Z.Pal.Pf.I/1a.



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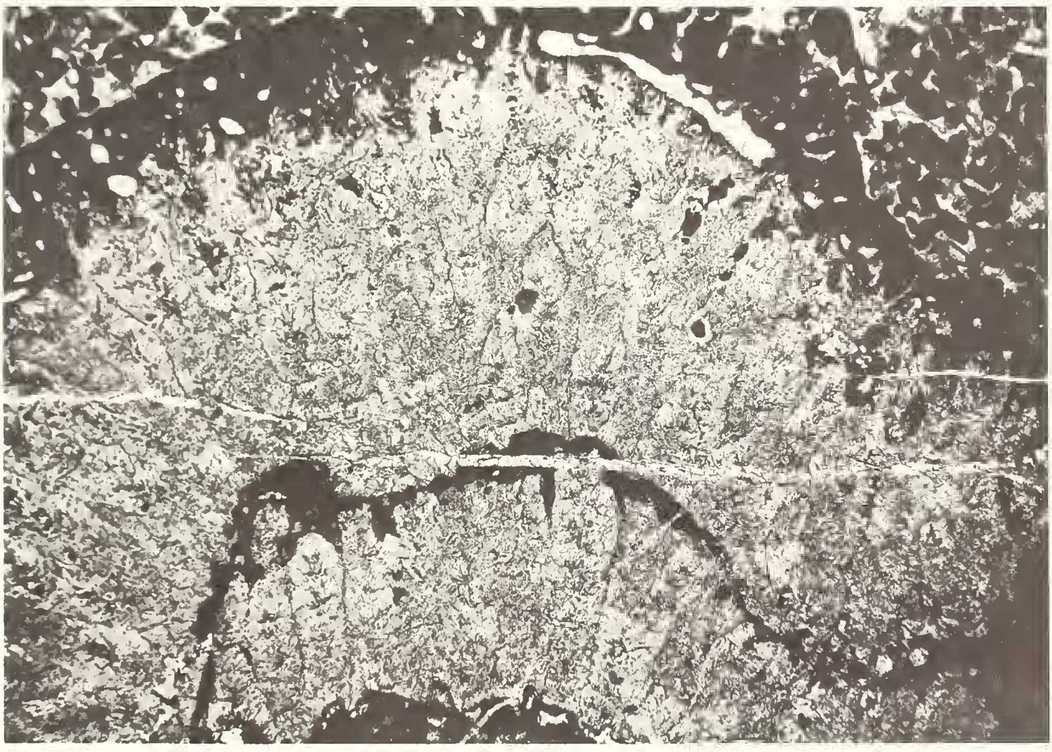
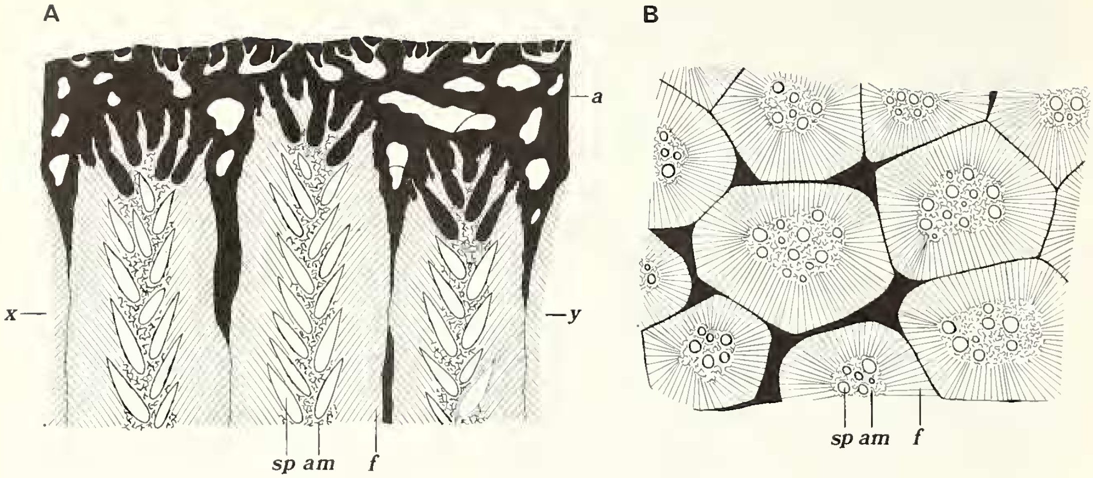


KAŹMIERCZAK, Cretaceous sclerosponge




TEXT-FIG. 1. *Murania lefeldi* gen. et sp. nov. Diagrammatic details of the skeleton structure in (A) longitudinal and (B) transverse section, ×50.

*a*, encrusting codiacean alga *Lithocodium aggregatum* Elliott; *sp*, spicules (styles); *am*, central flocculent calcareous zone of columns; *f*, outer fibrous calcareous zone of columns.

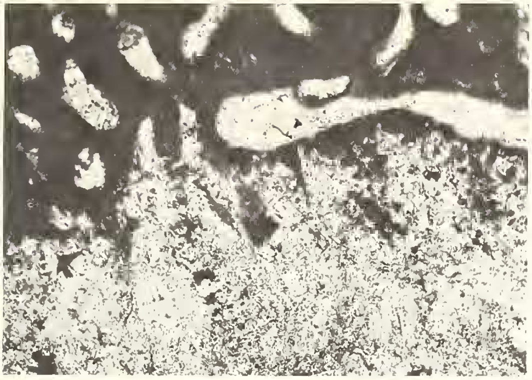
Note the calcareous processes on the top of the columns, the dark algal substance infilling the uppermost spicules (A) and the irregular zones (black) between the columns (A and B).

A, based on thin section Z.Pal.Pf.I/1a; B, based on thin section Z.Pal.Pf.I/1b.

and the considerably thicker spicules are arranged in vertical zones. However, the massive encrusting skeleton and the numerous sharp processes surrounding the spicules on the upper surface resemble the condition in recent species of *Hispidopetra*, *Stromatospongia*, and *Goreauiella* described by Hartman (1969). The spicules in these recent forms are much thinner and are scattered within a compact skeleton. This skeleton is composed of typical sclerodermites gathered in trabeculae analogous to the fibrous columns of *M. lefeldi*. The irregularly polygonal cross-sections of the columns in *M. lefeldi* are similar to the irregularly pentagonal or, less frequently, hexagonal cross-sections of the skeleton elements of another recent sclerosponge, *Ceratoporella nicholsoni* (Hickson). The walls of these elements can be considered equivalent to the outer columnar zone of *M. lefeldi*. However, the walls in *C. nicholsoni* surround hollow pits and the spicules (acanthostyles) are scattered vertically within the walls (Hickson 1911; Hartman and Goreau 1970), never forming regular

EXPLANATION OF PLATE 46

Figs. 1–7. *Murania lefeldi* gen. et sp. nov. 1, longitudinal section of a sclerosponge upper surface with processes covered by codiacean alga *Lithocodium aggregatum*, ×40. 2, 3, longitudinal sections through the corroded surface of the sclerosponge showing pseudomorphs after siliceous styles infilled by a darker algal carbonate, ×40. 4, a few calcite pseudomorphs of styles (?acanthostyles) in longitudinal section of a column, ×150. 5, longitudinal section through a surface of a sclerosponge with partially corroded pseudomorphs of spicules infilled by dark algal carbonate, ×70. 6, longitudinal section of three columns in polarized light showing their flocculent central zones and their fibrous fasciculate outer zones, ×40. 7, transverse section through the columnar units showing their irregularly polygonal outlines, ×40. Figs. 1–6, thin section Z.Pal.Pf.I/1a. Fig. 7, thin section Z.Pal.Pf.I/1b.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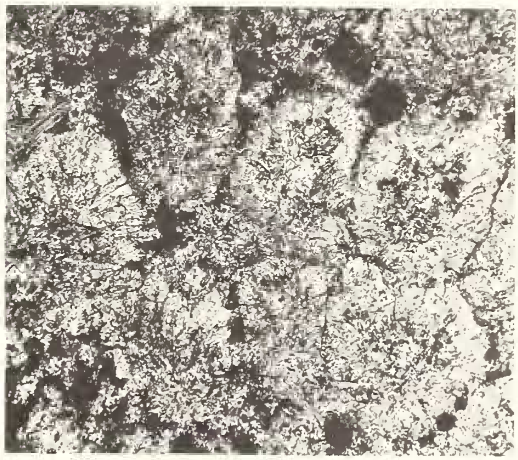

KAŹMIERCZAK, Cretaceous sclerosponge

clusters. In another recent sclerosponge *Merlia normani* Kirkpatrick, irregularly polygonal vertical elements are filled with soft tissue within which bunches of siliceous spicules can be found. Unlike *M. lefeldi* the spicules in *M. normani* are not incorporated during growth of the sponge into the calcareous skeleton (Kirkpatrick 1911).

Several Mesozoic forms generally described as Hydrozoa or Stromatoporoidea (Sphaeractinoidea) most probably belong to the Sclerospongiae and are similar to *M. lefeldi*. These are '*Stromatopora*' *japonica* Yabe, *Dehornella crustans* Hudson, *Dehornella choffati* (Dehorne), *Astroporina stellans* Hudson, *Astroporina orientalis* Hudson, *Parastromatopora jurensis* Schnorf (Yabe and Sugiyama 1935; Hudson 1960; Schnorf 1960) from the Upper Jurassic, and *Astroporina valangiensis* Schnorf (Schnorf 1960; Hartman and Goreau 1970; Stearn 1972) from the Lower Cretaceous. In all these forms, elongated clear areas, which radiate upwards, are visible in the axial zone of the fibrous vertical elements (pillars). These areas are similar in shape and size to the spicules of *M. lefeldi* and probably represent calcite pseudomorphs after siliceous styles. This assumption is based on the identical preservation of the spicules seen in many parts of the *M. lefeldi* skeleton. All these species differ from *Murania lefeldi* in that they have skeletons divided into a system of irregular vertical elements and much thinner horizontal tabules, with rather large interskeletal spaces.

If the removal of some Mesozoic 'Hydrozoa' to Sclerospongiae seems to be justified on the basis of traces of primary spiculation found in their calcareous skeletons, then the affinity of sclerosponges to the Palaeozoic Stromatoporoidea suggested recently by Hartman and Goreau (1966, 1970) and Stearn (1972) is, in my opinion, open to question. The structural and microstructural changes in the evolution of the Palaeozoic Stromatoporoidea (Kaźmierczak 1971) can be explained either by the poriferan or the coelenterate affinities of these organisms. In both cases it seems likely that the basally secreted skeleton performed the same supporting function. The main argument against sponge affinities of the stromatoporoids is the absence of spicules in their skeletons. The spicules described by Newell (1935) in the Pennsylvanian '*Parallelopora*' *mira* Newell appear to be artefacts and, in the opinion of Flügel and Flügel-Kahler (1968) and Stearn (1972) this form has nothing in common with the stromatoporoids. Even if it were accepted that all Palaeozoic stromatoporoids possessed, like *Merlia normani*, spicules not incorporated in the calcareous skeleton, then one would expect to find at least some signs of spicules preserved in the interskeletal spaces or in the surrounding sediment. The preservation of distinct spicules in *Murania lefeldi* in strongly folded Lower Cretaceous sediments contradicts Hartman and Goreau's (1970) suggestion of quick, even pre-burial corrosion, and dissolution of the spicules. In their opinion this would be responsible for the absence of spicules in Palaeozoic stromatoporoids.

The similarities between the exhalant canals of the sponges and the astrorhizae of the Stromatoporoidea which, according to some authors (Rosen 1869; Twitchell 1929; Hartman and Goreau 1966, 1970; Stearn 1972) would be the crucial evidence for the poriferan affinities of these fossils, are superficial, and bear only on the external appearance of these structures. It seems unlikely that the complex systems of astrorizal canals, always cut by tabulae or dissepiments, could be equivalent to the soft, tube-like exhalant canals of the Sclerospongiae or other sponges. These soft canals rarely leave any traces in the skeleton and those that remain are only very superficial impressions. The affinities of the Stromatoporoidea remain a geological enigma. It is likely that the fossil 'Hydrozoa' presently including the Palaeozoic Stromatoporoidea (with some marginal forms), Mesozoic Spongiomorphida and Sphaeractinoidea (with several enigmatic forms) are a heterogenic group with coelenterate, sponge (sclerosponge), algal, and other affinities.

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JÓZEF KAŹMIERCZAK

Institute of Palaeozoology
Polish Academy of Sciences
Al. Żwirki i Wigury 93
02089 Warszawa, Poland

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